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DISTINCT IGNEOUS APXS ROCK COMPOSITIONS ON MARS FROM PATHFINDER, MER AND MSL

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The alpha particle x-ray spectrometer (APXS) on all four Mars Rovers returned geochemical data from about 1000 rocks and soils along the combined traverses of over 50 kilometers. Here we discuss rocks likely of igneous origin, which might represent source materials for the soils and sediments identified along the traverses.

Adirondack-type basalts, abundant in the plains of Gusev Crater, are primitive, olivine bearing basalts. They resemble in composition the basaltic soils encountered at all landing sites, except the ubiquitous elevated S, Cl and Zn in soils. They have been postulated to represent closely the average Martian crust composition. The recently identified new Martian meteorite Black Beauty has similar overall geochemical composition, very distinct from the earlier established SNC meteorites. The rim of the Noachian crater Endeavour, predating the sulfate-bearing Burns formation at Meridiani Planum, also resembles closely the composition of Adirondack basalts.

At Gale Crater, the MSL Curiosity rover identified a felsic rock type exemplified by the mugearitic float rock JakeM, which is widespread along the traverse at Gale. While a surprise at that time, possibly related more evolved, alkaline rocks had been previously identified on Mars. Spirit encountered the Wishstone rocks in the Columbia Hills with ~ 6% Na₂O+K₂O, 15 % Al₂O₃ and low 12% FeO. Pathfinder rocks with elevated K and Na and >50% SiO₂ were postulated to be andesitic. Recently Opportunity encountered the rock JeanBaptisteCharbonneau with >15% Al₂O₃, >50% SiO₂ and ~ 10% FeO. A common characteristic all these rocks is the very low abundance of Cr, Ni and Zn, and an Fe/Mn ratio of about 50, indicating an unaltered Fe mineralogy.

Beside these likely igneous rock types, which occurred always in several rocks, a few unique rocks were encountered, e.g. Bounce Rock, a pyroxene-bearing ejecta rock fragment resembling the Shergottite EETA 79001B meteorite. The APXS data can be used to relate the findings of all 4 landing sites, constrain the water to rock ratio of sediments or imply source rock provenance. Beyond that the capability to quantify important volatile elements like P, S, Cl, and Br have provided new insights into the chemistry and the environment present during the formation of the sediments.

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